

THE ELECTRIC LIGHT ILLUMINATION

UPON THE SYSTEMS KNOWN AS

GRAMME, WESTON, MAXIM, NICHOLS, ETC.

Under Proprietary Rights, for the Dominion of Canada, of the

CANADIAN ELECTRIC LIGHT COMPANY,

No. 17 PLACE D'AMES, Montréal.

The *Canadian Electric Light Company* has acquired the latest and the most complete patent rights bearing upon the subject of illumination by electricity. These proprietary rights extend even to discoveries that may be made in the future, and which shall come under the control of the great Electric Light Company of the United States, doing business in New-York, and which has a vast amount of capital at its disposal.

The production of electricity has now become simply an industrial problem ; it is more easily controlled and regulated than steam. Thanks to the new machines, it is no longer dependent upon the glass friction-wheel, the zinc-and-copper battery, or the Voltaic pile seen in laboratories. A simple iron drum with a copper wire coil, turning cylinder-like between (but without touching) two magnets, which are also covered with coils of copper wire—such is the complete mechanism. There is no friction even ; it is simply a matter of vibration ; and if this drum be made to vibrate during the whole year, it will produce electricity all the year round without the least interruption. No ingredient enters into the production of the mysterious current, which, from this very cause, is inexhaustible and unlimited. To set the machine going, all that is required is a motive power.

The above is a brief explanation in popular language of the generator known as the dynamo-electric machine, which is capable of producing currents of the greatest power ; in fact, so intense is the current produced by one of these machines above, when driven by a steam-engine of fifty horse power, that it will give a light equal in brilliancy to a hundred thousand candles.

Under conditions such as these, it may be said without fear of contradiction that electricity has now entered into the field of industry, since the production of the current is, henceforth, dependent upon a mere mechanical effect. The instrument, once adjusted, requires no attention ; and any mechanic of ordinary intelligence may draw at will light or

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motive power from this machine with the same facility as he draws light or power from his furnace. Nor is this apparatus liable to work capriciously, because it is simplicity itself. The two bearings supporting the shaft of the revolving drum are the only friction points: this gives an absolute assurance of the stability of the current.

It is not intended to give in these notes a full account of the various industrial uses to which this machine may be put; we would call attention however to the vast interests involved in the utilization of our natural water-powers. The transmission of hydraulic power by means of electricity is a problem which has received a full solution. In causing a drum or bobin the revolve between two magnets, as explained above, an electric current is produced; but if a current is sent from another place to a machine which is at rest, the drum or bobin of this machine will immediately begin to revolve with a force proportioned to the intensity of the current. Now, if, to the shaft, or axle, of this bobin a pulley be attached, on which a belt may be adjusted, this pulley will answer all the purposes of a main shaft, or drum, revolving by steam power, by communicating the motion to the machinery of the work-shop. A motive-power may be obtained from one of these machines alone, or from one to twenty-five horses; and this power will be as constant, as powerful, and as useful as steam-power itself.

The importance of this transformation of electricity into motive-power is very apparent as regards great centres. Imagine a water-power of any kind at a few miles' distance from a city; it is possible, by means of a simple wire, to transmit from an electrical engine-room, situated at the water-power, to a thousand work-shops in the city all the motive-power which they may require. The loss of power which occurs in such transmission has even been ascertained.

It is found that if a machine receives an impulsion equal to fifty horse-power, at the starting point, only a power of twenty-five horses will be transmitted to the point of delivery; thus, if the water-power be of 40,000 horses, a motive-power of 20,000 horses may be distributed over a few copper wires to all parts of the city, according to the requirements of each consumer. Engines and boilers are dispensed with; and neither coal nor water is required to make steam; no engine-driver nor taker is wanted; no extra insurance against fire; no costly moving into the premises and fitting up; no waste of valuable space. An apparatus two feet square, and weighing three hundred pounds or less, placed in a corner of the factory, in a cellar, or in a garret, will answer to every requirement of a motive-power; and after deducting the general expense of a dam, and the first outlay, this motive-power of 20,000 horses will cost no more than the millions of gallons of water which run and are lost in the river.

As to the electric light, the problem has been solved quite as advantageously to the consumer. Without going into details, we shall offer an explanation of the two systems already in existence.

THE ELECTRIC LIGHT.

All the different kinds of apparatus by electric energy is transformed into light may be arranged into two leading classes, namely :

- 1st. The Voltaic arc, or great light.
- 2nd. The incandescent or divided light, for use in the interior of houses.

This general classification nevertheless admits of some systems which may properly be classed between the Voltaic arc and the incandescent light, as they are related to each of these.

THE VOLTAIC ARC.

The apparatus to produce the Voltaic arc are of two kinds, namely :

- 1st. Carbons placed in *prolongation* one of the other ; these are the *lamps or regulators*.
- 2nd. Carbons placed *parallel* to each other ; these are the *candles*.

Candles such as Jablockoff's are not much in fashion.

The name of *regulator* is given to all systems employing more or less complicated mechanism to keep the carbon points apart at their normal distance from each other. A distinction might be drawn between regulators fed by continuous currents and those fed by alternating currents ; this, however, is relatively a secondary feature, and it is better to look to the light itself to establish subdivisions. An important characteristic, which establishes a well marked division, is the number of lights fed by one machine *on the same circuit*.

The following are distinguished, namely :

(a.) Voltaic arc *monophotic* regulators, that is to say, those which admit of only one apparatus being placed on the circuit.

(b.) *Polyphotic* regulators, or, as they are often called, *dividing regulators*, with which 2, 3, 4 and even 40 lights may be placed on the same circuit. It may be observed in passing that a dividing regulator may be used as a monophotic regulator, by placing one light on a circuit of appropriate power, but that a monophotic regulator cannot be used reciprocally. These work poorly, or not at all, when several are placed on the same circuit.

The light of the Voltaic arc is best adapted for exterior illumination, because the rays of the electric lamp are identical with those of the sun. A solar ray, falling upon a given space, is equivalent to 5,774 candles at the distance of one foot ; an electric lamp emits precisely one half of this light ; and it is a singular fact that the electricians of Europe have applied the electric light with the greatest success to promote vegetation during the night. The celebrated Dr. Siemens, a member of the firm of that name who manufacture all the Transatlantic cables and by whom an electric railway has just been opened near Berlin, has demonstrated the fact that plants and fruit exposed to the action of electric light conti-

nuously during the night arrive at maturity sooner. The electric light has the same effect as the sun in promoting the decomposition of carbonic acid in vegetables and in arresting the injurious effect on plants of radiation from the earth during the night.

THE INCANDESCENT LIGHT.

The incandescent light, invented quite recently, is of far greater importance than the light of the Voltaic arc, and is destined to play an important part in the interior illumination of houses. From the moment that it is found possible to divide the electric current at will the matter no longer offers any great difficulty. The leading inventors of this system, Maxim and Edison, have kept lights constantly burning at New York for six months past which have not failed one minute during all that time. The light has been tried at Montreal, particularly at the St. Lawrence Hall with the same satisfactory results. This system of illumination is very simple. Electricity, as every body knows, follows a conducting wire: if the current meets on the way a body less accommodating than the copper wire, a struggle immediately ensues. If this body is not a conductor of electricity at all, the current is beaten and its career is ended; but if this body is merely an imperfect conductor, one through which the current can pass with some difficulty, heat results from the struggle and the obstructing body is set on fire. In the open atmosphere, the struggle would be over in the half a second, and the resisting metal or body would be melted or consumed almost immediately; by confining the warring elements within a hermetically sealed glass globe however, about the size of a pear, and from which the air has been extracted, the inconvenience that would result from the destruction of the resisting body is avoided. The resisting body which the current has to encounter in the globe is a small piece of card, reduced to carbon and cut and bent in the form of an M with rounded angles. It is, of course, within the globe that the struggle takes place. The piece of card, a bad conductor of electricity, takes fire, and remains in an *incandescent* state as long as the current passes through it; it may be a whole night, a whole week, or during three months if the generator is kept in motion so long, because the combustion of the card cannot take place in a *vacuum*. This incandescence produces a soft, golden light, exactly similar to a gas jet; it is neither stronger nor weaker than gas, but it possesses three advantages over gas. 1st. It is perfectly steady, digering in this respect from gas which flickers continually. 2nd. As it burns in a *vacuum*, it does not consume, like gas, the oxygen we breathe, nor does it give off carbonic acid which is injurious to silver-ware, gilding and oil paintings. Nor does it heat the atmosphere. 3rd. Lastly it cannot set fire to the premises, nor cause suffocation, because, if the globe should break, the light would be extinguished instantly on the first fissure appearing in the glass. This system is

now working perfectly; ingeniously constructed apparatus provided for everything, and the lights may be distributed throughout the house in the same manner as gas lights and may be lighted and extinguished at pleasure. When a hundred lights are burning, it is possible to extinguish ninety-nine without thereby increasing the current that is being transmitted to the only remaining light; and all the lights in the house, or only a portion of them, may be lighted at pleasure by simply turning a key in one place.

But, it will be asked. What about the cost? The following data may serve as a base for more complete estimates: If electricity is supplied by water-power, the cost is almost *nil*, as, in that case, it is in reality the motion of the water in the river that is being changed into light, which may be kept burning night and day without making any one poorer as no material is consumed. If steam-power is required, the estimate may be based on the fact that one horse of steam-power will supply eight house lights. With a steam-engine having the recent improvements two pounds of coal per hour are consumed for each horse-power, or $\frac{1}{4}$ of a pound of coal to each light. A light kept burning six hours every day during the whole year, will require 547 pounds of coal, or about 24 cents' worth. A gas jet consuming six feet per hour will, in the same space of time, require 13,140 feet of gas, to produce which 2,628 pounds of coal will be necessary, one ton of coal being used in the manufacture of 10,000 feet of gas.

INCANDESCENCE

The systems of illumination by incandescence are far less numerous than those dependent upon the Voltaic arc; consequently their classification is not so complex. The incandescent systems are divided into two classes, namely;

- 1st Incandescent lamps with combustion.
- 2nd Lamps purely incandescent.

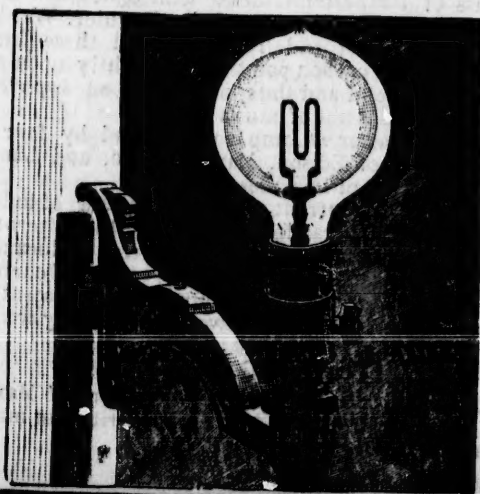
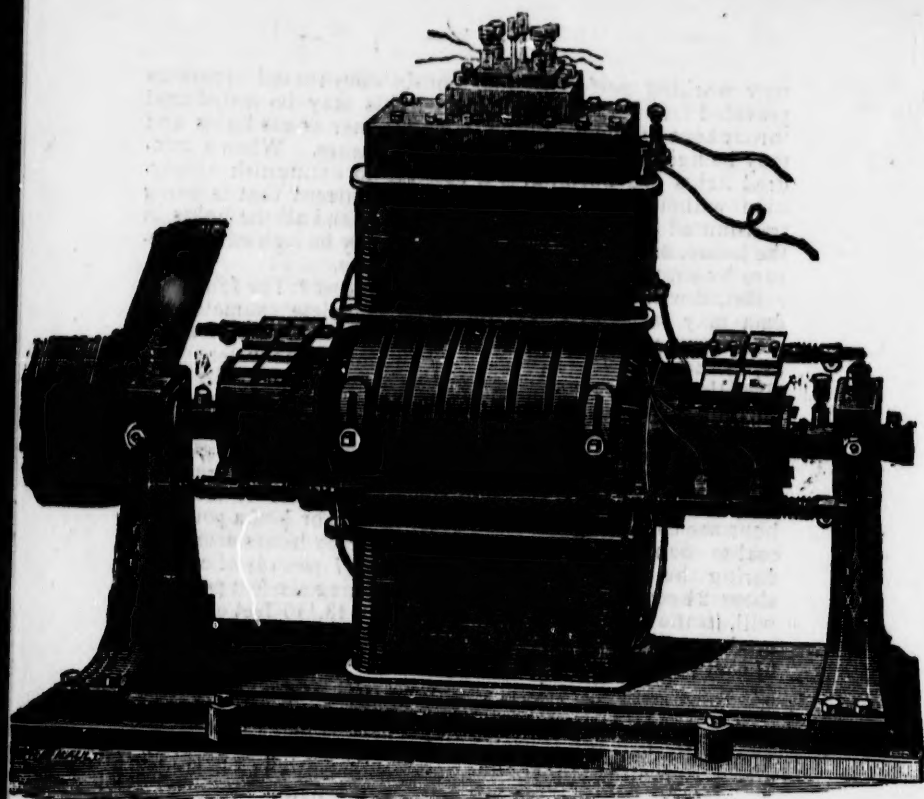
The class of *incandescent lamps with combustion* is represented by the apparatus invented by Reynier, Werderman (Napoli patentee), Joel and Tommasi. All these lamps are constructed with a carbon point resting lightly upon a block of carbon or of metal and thus producing an *imperfect* contact. This system is not of much value.

The *purely incandescent* lamp is represented by four different systems, that of Edison, Maxim, Swan, and Lane Fox. All these lamps are of incandescent carbon.

The nature of the current is almost a matter of indifference in the case of incandescent lamps; they operate with either a continuous or an alternating current. Incandescent lamps with combustion require a large *volume* of current and are worked with *tension*; while purely incandescent lamps require a small volume and are worked generally with *quantity*.

SCIENTIFIC OPINIONS.

The following opinions upon the systems of Maxim and Weston are taken from the highest authorities in matters of electrical science:



THE MAXIM LIGHT

AS PRODUCED BY THE UNITED STATES ELECTRIC LIGHTING COMPANY

From the New York Graphic May 5th 1881

The rapid advance made in the application of the electric force to the uses of common life is one of the marvels of the age. Ingenious inventors and keen-witted discoverers in all parts of the civilized world have bent their energies to the task of wresting from Nature the secrets she has held. Repeated experiment, repeated failure and final success mark the progress of the investigation. Rivalries have but stimulated invention; one scientist has trodden close upon another's heels, one company of capitalists has gone a step further than its competitor in developing newly-found resources, and the general public is the gainer by all that has been produced. From the Atlantic Cable of 1858 to the electric light of 1881 is a long stretch, representing incessant labor, high ambitions, manifold applications of scientific skill, wonderful displays of profound learning. What the next quarter of a century will produce may reasonably be inferred from what has already been accomplished.

Readers of current literature are aware, not only of the progress of discovery in reference to the application of the electric light to practical uses, but are cognizant of the respective claims put forth by rival inventors, some of whom have promised, honestly enough, but mistakenly, to do more than they could perform, being, so to speak, the victims of circumstances beyond their control. Others, achieving partial success, have won reputation and profit. From time to time our newspaper and magazines have described the newest efforts, and the appetite to the public has been whetted accordingly but has never until now been wholly satisfied, and for a very sufficient reason. For, although great stores and warehouse have been brilliantly lighted up by the electric light, streets illuminated and steamships equipped with machine whose rays can pierce dense fogs, two problems have been left unsolved until now. One of these problems was the discovery of the best method of controlling and regulating—the night, the other was the question of cost—a consideration to householders, especially, who suffer under the exactions and impositions of the gas companies. Both of these problems are now satisfactorily solved.

The Maxim light, which is illustrated in this issue of THE GRAPHIC, is found, by a long series of severe practical tests, to contain several invaluable qualities not possessed by any other electric light in existence. It is produced at a cost much less than that of gas, and gives more than twice the light that gas furnishes; it creates no appreciable heat; it is adjustable by the ordinary gas stop cock; its carbon burner, instead of wearing out speedily, repairs itself and lasts for many months, and its flame is pure and steady. The United States Electric Lighting Company, of which Mr Charles R. Flint is



Presidents, holds the Maxim patent, and Mr Eaxim is himself one of the consulting electricians of the company, among whose advisers are also professor Morton, Professor Barker, of Philadelphia ; Professor Moses G. Farmer, of the United States Torpedo Service, and other distinguished scientists. The company owns altogether about one hundred patents, and business is flowing in upon it in a steady stream, necessitating the erection of a new factory, which is now in process of construction on Avenue Band Seventeenth street.

OUR ILLUSTRATIONS :

show two interiors illuminated by this light. One of the views represents the elegant drug store of Caswell, Hazard & Co., under the Fifth Avenue Hotel, as viewed from outside, showing the convenient arrangement and the extreme brilliancy of the electric lights, the other is a view of the art gallery of the Union League Club on Fifth Avenue, into which these lights were introduced last week, with singularly beautiful effects. A representation of the lamp used for this light is also given.

The peculiar advantages of the United States electric light are : (1) its perfect steadiness ; (2) its brilliancy—each lamp giving a light of twenty-four candle power, (3) its cheapness as compared either with gas or other electric lights ; (4) its adaptability for household and private use ; and (5) the absence of heat. The company has not sought newspaper publicity, preferring to perfect its process and to make the light it furnishes satisfactory to its customers by constant improvement and watchfulness ; but now, satisfied that the desired result has been attained, it challenges the attention of the public, and defines its future purposes in the following statement by its President, Mr. Flint, which we copy from the *Evening Post* of Saturday last.

" Six months ago we bought the six story building at Seventeenth street and Avenue B, and immediately ordered an immense quantity of machinery. Owing to the revival of manufactures all machinists have been far behind their orders for the last year, and we are only now getting what we ordered. The boiler and some of the engines are in, besides the shafting and belting throughout the whole building. In six weeks we expect to have our machinery in, and at least one thousand men at work turning out dynamos, lamps and motors.

" At present we have three factories actively at work supplying such material as we need in order to extend our business at a slow rate—say of a building a day. In twenty-fifth street we have a small shop, in Twenty-seventh street another, and on Sixth Avenue one that has been running for a year and a half. The building in Sixth Avenue is six stories high and will probably be the station for one of our up-town districts. We are already lighting from it several shops, Caswell & Hazard's drug store, the card rooms of the Union Club and some of the apartments in the Cumberland building,

at Twenty-second street and Broadway. The Union Club members are so well pleased with the light in their card rooms that we expect to put electric lights all over the building. The *Evening Post* spoke of the success of the lights at the Union League Club reception; not an hour's trial was necessary to demonstrate their superiority to gas. In the same way we use a part of the basement of the Equitable building as a miniature station in order to furnish light to the Equitable building and such offices in the neighborhood as may desire the light. For more than a year we have lighted the Post-office at one-third of the cost of gas, and for the last six months parts of the Equitable building, the banking offices of Fisk & Hatch, Hatch & Goote, and two banks have been lighted up by our lamps. Last week we put the light into the new vault of the Stock Exchange; tomorrow the Maritime Exchange in Beaver street and the offices of W. T. Hatch will be lighted with them; on Saturday the offices of Phelps & Stokes and W. R. Grace will be added to the list. But the real beginning will be made when we get our Seventeenth street building going and organize a down-town station.

"At first we do not intend to charge less for our light than the price of gas. The competition will cause the gas companies to lower their prices, and then *we shall follow them down, and end by making prices lower than they can manufacture gas for.* Within a year gas will not be worth more than \$1 per 1,000 feet; our standing offer to every householder will be to give electric light at the same price as he has been paying for gas. As the light is pleasanter, steadier, healthier and safer than gas, and there being *absolutely no danger from fire*, we expect the public to take our light in preference to gas at the same or even a slightly lower price. In three months we expect to be able to make that offer to every person needing light. Each house or office will be supplied with a certain number of extra lamps, so that if one of those in use gives out a new one can be put on with no more trouble than replacing the chimney of an oil lamp. We find that the incandescent lamp will be used entirely in the interior of buildings, the arc light being too strong and too unsteady; it gives an immense quantity of light, and is just suited to the street, but quality is what is wanted for houses."

The light of the future seems at last to have been secured, after much travail and tribulation. The success which has attended the efforts of the skilful electricians and the enterprising capitalists whose services have for a long time been unremittingly but quietly devoted to the interest of the United States Company, proves beyond question that the desideratum of getting a brilliant electric light at a price less than that of gas, and better adapted for household use than gas, has been attained. A new era begins with the introduction of the light to which THE GRAPHIC to-day invites the attention of its readers. It is to be remembered, moreover, that this is no untried experiment. On the contrary, the Maxim light is in

constant and satisfactory operation at the following named places among others :

Caswell, Hazard & Co.'s drug store, Fifth Avenue Hotel,
Union League Club Art gallery, Fifth Avenue and Thirty-
ninth street.
Union Club, Fifth Avenue and Twenty-second street.
Equitable Building, No. 120 Broadway.
Mercantile Trust Company, No. 120 Broadway.
New York Stock Exchange.
New York Post Office.
The Tribune Building.
Fisk & Hatch's banking house.
Hatch & Foote's banking house.
The Maritime Exchange.
Cumberland Building, Broadway and Twenty-second
Street,

THE MAXIM ELECTRIC LIGHT

From the *London Times*, May 31th, 1881.

Among a few system of electric lighting which have occasionally been heard of, but which hitherto have not been seen in this country, is that of Mr. Maxim, of the United States, in which country the light is stated to be in considerable use and in good repute. A successful demonstration of this system took place on Friday evening last in the presence of a number of scientific gentlemen who assembled at the Albany Works, 374, Euston-road, London. It is an incandescent system, and comprises a generator, a regulator, and a burner or lamp. The prime generator is a small dynamo-electro machine, which is driven at about 200 revolutions per minute. In this machine a current of electricity is generated, which is conducted to a second machine of similar construction, but of larger size. The current from the first machine is caused to circulate in the electro-magnets of the second, thus exciting the magnetic field of the latter. The small machine, or exciter, is provided with an ingenious device for controlling the supply of electricity and regulating the current, in order to meet the requirements of the number of lights burning, which may be constantly varied, without either detriment to the machine or alteration in the other lights. This is called the Maxim regulator, and consists of an arrangement of electro-magnets. The brushes collecting the current generated by the exciter, together with the brush holders, are made to move round the axis of the machine, and are automatically set to any position between the maximum and the neutral points. Two pairs of electro-magnets at the top receive a proportion of the currents of the large and small machines respectively, one pair operating the regulating movement and the other a shunt.

The regulator is operated by means of an armature attracted with forces varying according to the number of lights in cir-

cuit. When the supply of current becomes insufficient by reason of additional lamps being lighted, the armature being released in one direction and attracted, in the other by means of a spring, a pawl, which is suspended from this armature causes the brush holders to revolve, an intermediary system of gearing being brought into play, thus supplying a greater volume of current. When the current becomes too great in consequence of the removal of some of the lamps from the circuit, the opposite phenomenon occurs. The electro-magnets forming the second pair are so constructed and adjusted that they only act upon their armature when a large increase of the current passing through them takes place, such as would happen if a main wire were broken, or if any other accident occurred. In such an event this armature is strongly attracted, and overcoming the tension of the spring brings its free end in contact with a platinum point, thereby cutting the field magnets of the exciting machine out of the circuit and stopping the generation of the current until the accident is remedied. There is thus a complete safeguard against injury to either the machine or the lamps. The large machine consists of two distinct parts built into one on the same frame and spindle. They are coupled together, and an ingenious and simple contrivance is provided at the top of the machine by means of which the currents supplied by each of the two machines can instantly be disconnected or coupled either in quantity or tension as required. This machine is driven at a speed of about 900 revolutions per minute. It is claimed that this machine will maintain 85 Maxim lights of 25 candle-power each, making an aggregate light of 2,125 candles. The machine is said to be capable of giving a single arc light or 20,000 candle power. A second machine of the same power as the one just described was also used, and was driven at the same speed.

These machines supplied the current which fed 120 lamps placed in various rooms from the basement to the 5th floor of the building, and including the passages and staircases. The lamps are arranged in multiple circuit, each burner being independent of the other. The current is conveyed through a main leading wire with its branches, sub-branches, and lamp wires to the burners. All these wires are arranged similarly to the ordinary gas main and branch pipes. The gas fittings, when available, are used as a return wire: any other pipes, however, such as water pipes, can be used for this purpose. The burner consists of a carbon filament made from cardboard, and having the form of a double loop. It is contained in a small hermetically-sealed glass globe or bulb, in which, it is stated, there is an atmosphere of gasoline, which prevents the deterioration of the carbon filament. By this means a kind of renovating process is said to be constantly taking place. The two ends of the filament are connected with the two poles of the machines, and the light is, the tap actuating a switch arrangement. The life of the lamp has not yet been ascertained, but it is stated that it will

last from 600 to 900 hours. The lamps can be taken out of and replaced in their fittings with ease. They can be fixed to any existing gas fittings, some being so fitted at the Albany Works. The great bulk, however, were fitted in elegant chandeliers of various types, which have been lent by Messrs. Hulett and Co., of High Holborn, for use during the exhibition of the Maxim system, which it is intended shall be continued to the end of June. On the ground-floor of the building some of the suspended lamps were burning in globes containing water, thus illustrating the adaptability of the system for submarine work or exposure to wet. The arrangements generally were such as to illustrate the suitability of the system for use in lighting dwelling-houses, all the various details of the lamps being such as could easily be understood and controlled. Assuming that a central station existed for the production of the current, it was shown that the lighting of a whole house could be instantly effected. In the same way the whole number of lights in a room or any portion of them can be as easily turned on or off. In fact, nothing can exceed the simplicity and ease of the manipulation.

The machines were driven by a semi-fixed steam-engine of 20 horses power nominal, supplied by Messrs. Ransones, Head and Jefferies, of the Orwell Works, Ipswich, and similar to the one which has so successfully driven the electric lighting machinery on the Thames Embankment for the past two years and a half. The demonstration took place under the auspices of Mr. N. de Kabath, and during the evening, the various advantages of the light were fully shown, and the sensibility of the governing machinery was exemplified by Mr. Lockwood. The light produced is softer and more agreeable to the eyes than any we have yet seen, and it is the first demonstration we have attended without experiencing a painful contrast upon either quitting or re-entering the gas-lighted streets. There was really a great surplus of light exhibited, the volume being magnificent, but not intensely bright and dazzling. Altogether the demonstration was a thorough success, and showed that the latest addition to the list of electric systems for interior illumination would prove a worthy competitor for honours.

THE MAXIM ELECTRIC LIGHT.

(From the *London Draper*, June 10 1881.)

We received an invitation to be present on Friday week at the Albany Works, 347, Euston-road, London, to witness a series of experiments in electric lighting by incandescence on Maxim's system, where a number of scientific and literary gentlemen were assembled. The experiments are of considerable importance to drapers, as a clear, inexpensive light of 25 candle power, without heat, will be a boon indeed to

our crowded business establishments, and the general adoption of one form or other of the electric light in our large houses has now become but a matter of time. The injury done to delicate fabrics, too, by the smoke and vapours arising from the burning of gas will make any system of electric light which is easy and simple of application doubly welcome. This the Maxim system promises. While the public have been waiting for Mr. Edison to perfect his invention, two incandescent systems have been introduced—the Swan and the Maxim. It is the latter which we now describe, the technical portion of the report being taken from the *Times*.
